

**APPLICATION
FOR
UNITED STATES PATENT**

**ELECTRONIC DISPLAY MODULE
HAVING A FOUR-POINT LATCHING
SYSTEM FOR INCORPORATION
INTO AN ELECTRONIC SIGN
AND PROCESS**

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FOUR-POINT LATCHING SYSTEM FOR INCORPORATION
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CROSS REFERENCES TO RELATED APPLICATIONS

5 [0001] None.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

10 [0002] The present invention pertains to electronic alphanumeric and graphic displays, and more particularly is for an electronic display module having a four-point latching system for incorporation into an electronic sign and process.

DESCRIPTION OF THE PRIOR ART

15 [0003] Prior art electronic display modules have often been secured to mounting panels or mounting channels and the like by labor-intensive fasteners requiring actuation of multiple individual fasteners such as screws, nuts, nut and bolt assemblies, and the like where numerous fastening operations occur during initial assembly or assembly in the field. Such fastening occurrences often require

20 labor-intensive manipulation and installation of fastening devices which are not part of the structure of the electronic display module and as such may not be readily available at the installation site. Clearly what is needed is a construction to facilitate rapid installation or changeout of electronic

25 display modules and which contains onboard fastening structure, such as is provided by the present invention.

SUMMARY OF THE INVENTION

5 [0004] The general purpose of the present invention is to provide an electronic display module having a four-point latching system for incorporation into an electronic sign and process.

10 [0005] According to one or more embodiments of the present invention, there is provided a latching system having four latches distributed at points or locations about an electronic display module wherein the major components, assemblies and other components include, but are not limited to, an LED display panel, a louver panel, a driver board, and a main housing having opposing mirror image-like latch mechanisms which are actuated by opposing actuator arms operated by an actuator gear disposed between the ends of the 15 actuator arms.

20 [0006] Each of the latch mechanisms, having commonality of components and structure, includes a latch housing extending from a panel which extends across the main housing, a latch having opposing inboard and outboard latch arms extending therefrom and extending through outboard and inboard slots in the latch housing, opposing latch posts extending outwardly from the central region of the latch, an attachment fixture at one end of the latch, and a latch lock plate which secures to an open side of the main housing panel 25 to assist in containing the latch within the latch housing and to assist in forming portions of slots located interior to the latch housing in which the opposing latch posts, and thus the latch, traverse in linear fashion. A linkage connects one end of the latch to one end of the actuating arm, and the 30 relationship of the actuating arm to the latch is such that the actuating arm maintains a restricted or an unrestricted

overcenter relationship to the latch. During initial latch transiting, such orientation is limited and constrained where the internal geometry of the latch housing and the latch lock plate causes the latch to maintain a non-rotated status when 5 transiting to position the latch arms over a mounting panel assembly. At the end of transiting, it is then desirable to rotate the latch to engage the structure of the mounting panel assembly. Additional movement of the actuating arm in the same direction urges the attachment fixture at one end of the 10 latch into a position which is unconstrained at the end of its travel, to be forced by the unrestricted overcenter force applied thereto by the linkage which then drives the attachment fixture of the latch into a recess in a guide body, thereby rotating the latch. Such latch rotation causes 15 impingement of the latch arms with the mounting panel assembly to cause securement thereto. In actuality two latch mechanisms are activated by the gear actuator in common therebetween. Although a four-point latching system is described, it is to be appreciated that other numbers of 20 latching mechanisms can be incorporated at other points of symmetric or non-symmetric latching mechanism locations.

[0007] One significant aspect and feature of the present invention is an electronic display module incorporating multiple latches to attach the electronic display module to a mounting panel assembly.

5 [0008] Still another significant aspect and feature of the present invention is an electronic display module having multiple latches having onboard self-contained latching mechanisms.

10 [0009] Another significant aspect and feature of the present invention is an electronic display module having multiple latches having opposing latch mechanisms which are operated by an actuator gear disposed between opposing actuator arms.

15 [0010] A still further significant aspect and feature of the present invention is an electronic display module having multiple latches where a guide body influences the deployment of a latch to allow restricted or unrestricted latch movement with respect to the overcenter relationship of the actuator arm to the latch.

20 [0011] A further significant aspect and feature of the present invention is an electronic display module having multiple latches incorporating an overcenter relationship of an actuator arm to a latch where during latch deployment the overcenter relationship is restricted and then unrestricted to cause the latch arms of a latch to be actuated in a linear straight direction over the structure of a mounting panel assembly followed by rotation of the latch to cause the latch arms to securely impinge the structure of the mounting panel assembly.

25 [0012] A still further significant aspect and feature of the present invention is an electronic display module

having multiple latches wher the latch housings are integral to the main housing.

[0013] Having thus set forth significant aspects and features of embodiments of the present invention, it is the principal object of the present invention to provide an electronic display module having a four-point latching system for incorporation into an electronic sign and process.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Other objects of the present invention and many of the attendant advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, in which like reference numerals designate like parts throughout the figures thereof and wherein:

[0015] FIG. 1 is a rear view of an electronic display module having a four-point latching system which is for incorporation into an electronic sign;

[0016] FIG. 2 is an exploded rear view showing the alignment of the major structural components of the electronic display having a four-point latching system to each other and to a mounting panel assembly;

[0017] FIG. 3 is an exploded front view showing the alignment of the major structural components of the electronic display module having a four-point latching system to each other and to a mounting panel assembly;

[0018] FIG. 4 is an isometric exploded view of the components comprising a latch mechanism and associated components including those components essential for the operation of one or more of the latch mechanisms;

[0019] FIG. 5 is an inverted view of a latch and linkage showing the relationship of the latch to the linkage;

[0020] FIG. 6 is a view of the latch mechanism being connected by an actuator arm to an actuator gear;

[0021] FIG. 7 is a rear view of the main housing where the gear support housings, the actuator gears, the actuator arms and the latches are not shown in order to reveal other structures residing on the panel;

[0022] FIG. 8 is a rear view of a portion of a latch housing of the main housing showing the relationship of the outboard and inboard slots to the outboard and inboard sidewalls, the top walls and the guide body;

5 [0023] FIG. 9 is a front view of the main housing where the latch lock plates and latches are not shown in order to reveal other structures residing on the panel including the geometry of the interior cavities formed in part by the structure the latch housings;

10 [0024] FIG. 10 is a front view of a portion of the latch housing of the main housing showing the relationship of the outboard and inboard slots to the outboard and inboard sidewalls, the top walls, the guide body and the louver pin receptor post;

15 [0025] FIG. 11 is a view of the main housing showing a portion thereof in cross section along line 11-11 of FIG. 8 and showing in exploded relationship components thereof prior to assembly;

20 [0026] FIG. 12 is a view like FIG. 11 but showing the components partially assembled;

25 [0027] FIG. 13 is a view of the main housing showing a portion thereof in cross section along line 13-13 of FIG. 8 with the components fully assembled and illustrating the longitudinal travel path of a first axis of pivotal rotation and the longitudinal travel path of a second axis of pivotal rotation which is rearward of and off center with respect to the longitudinal travel path of the first axis of pivotal rotation;

30 [0028] FIG. 14 is a view like FIG. 11 but showing the components fully assembled and also showing a portion of a

mounting panel assembly to which the main housing as well as all other parts associated therewith are to be attached;

[0029] FIGS. 15, 16 and 17 are views showing in sequence the various stages of the process involving attachment of the main housing and associated parts to a portion of the mounting panel assembly; and,

[0030] FIG. 18 is a plan view showing the outboard latch arm and the inboard latch arm engaged over and about a tab at the junction of a vertical plate and a horizontal plate of a mounting panel assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] FIG. 1 is a rear view of an electronic display module having a four-point latching system which is for incorporation into an electronic sign and which together with the process for incorporating it into an electronic sign constitutes the present invention. The electronic display module having a four-point latching system is designated in its entirety by the reference numeral 10 and includes a main housing 12, a driver board 14 secured to the back of the main housing 12, and a louver panel 16 and an LED display panel 18 (FIGS. 2 and 3) located at the front of the main housing 12. Also included are latch mechanisms 20a, 20b, 20c and 20d which are similar and of mirror image-like construction, which are comprised of parts in commonality, and which are located near the periphery of and substantially at the corners of a panel 22. The panel 22 extends across and comprises a portion of the main housing 12 and is bounded by a continuous configured peripheral wall 13. The latch mechanisms 20a, 20b, 20c and 20d include configured latch housings 24a-24d, respectively, and components which operate within and about the latch housings 24a-24d and which are part of or are associated with the latch housings 24a-24d. For brevity, only the structure of the latch mechanism 20a and closely associated components thereof are fully described. Some of the fully or partially visible components relating to and/or which are part of the latch mechanism 20a include the latch housing 24a, outboard and inboard latch arms 28 and 30 being part of a latch 26 (FIG. 4) extending through the latch housing 24a, and an actuator arm 32. One end of the actuator arm 32 connects to the latch 26, as later described in detail, and the other end communicates with an actuator gear 34

(FIG. 4) contained in a gear support housing 36 secured to the panel 22 midway between the latch housings 24a and 24b. Also shown in close proximity to the latch mechanisms 20a, 20b, 20c and 20d are a plurality of locator posts 38a-38d extending outwardly and rearwardly from the panel 22 for use in alignment of the main housing 12 with a mounting panel assembly 39 (FIGS. 2 and 3) to which the four-point latching system secures. Also shown are the upper portions of the louver panel attachment pins 40a-40e (and nuts) extending from the louver panel 16, through the LED display panel 18, and through and becoming visible at the upper regions of the latch mechanisms 20a, 20b, 20c and 20d, as well as the upper portions of the driver board attachment pins 42a-42d (and nuts) extending from the panel 22 through and becoming visible at the upper portion of the driver board 14. A flexible and pliable seal 44 is located at the periphery of the panel 22 for sealing against the mounting panel assembly 39.

[0032] FIG. 2 is an exploded rear view showing the alignment of the major structural components of the electronic display module having a four-point latching system 10 including the main housing 12, the LED display panel 18, the louver panel 16 and the driver board 14. The mounting panel assembly 39 to which the electronic display module having a four-point latching system 10 aligns and attaches is also shown. The mounting panel assembly 39 includes a series of vertical plates connected to a series of horizontal plates, of which only vertical plates 39a and 39b and horizontal plates 39c and 39d are shown. Tabs 41 are provided at the junctions of the vertical plates and the horizontal plates, and each tab is provided with an alignment hole 43. Additionally shown are pluralities of body holes in the LED display panel 18, the main housing 12, the driver board 14, and the mounting panel assembly 39. The LED display panel 18 includes a plurality of body holes 46a-46e placed as shown, the majority of which are near the periphery of the LED display panel 18 for accommodation of the plurality of louver panel attachment pins 40a-40e of the louver panel 16, as well as including a plurality of connectors 48a-48n which connect to corresponding connectors 50a-50n (FIG. 3) on the driver board 14. Access holes 52 and 54 in the LED display panel 18 for accessing the actuator gear 34 are also shown. Correspondingly, access holes 56 and 58 are also provided in the louver panel 16 for accessing the actuator gear(s) 34 through access holes 52 and 54 in the LED display panel 18. The driver board 14 includes a plurality of body holes 60a-60d for accommodation of the plurality of driver board attachment pins 42a-42d and a centrally located body hole 62 for the accommodation of the louver panel attachment pin 40e. Each

latch housing 24a-24d includes a body hole 64 (FIG. 4) for accommodation of the louver panel attachment pins 40a-40d. A body hole 66 is also located central to the panel 22 for accommodation of the louver attachment pin 40e. The panel 22
5 also includes four cutouts 68a-68d for accommodation and connection of connectors 48a-48n and 50a-50n therethrough.

[0033] FIG. 3 is an exploded front view showing the alignment of the major structural components of the electronic display module having a four-point latching system 10 including the main housing 12, the LED display panel 18, the louver panel 16 and the driver board 14. The mounting panel assembly 39 to which the electronic display module having a four-point latching system 10 aligns and attaches is also shown.

[0034] FIG. 4 is an isometric exploded view of the components comprising the latch mechanism 20a and associated components including, but not limited to, those components essential for the operation of one or more of the latch mechanisms 20a-20d. The main components included are the latch 26, the latch housing 24a, a latch lock plate 70, the actuator arm 32, a linkage 72, the actuator gear 34, and the gear support housing 36.

[0035] With reference to FIGS. 4 and 5, the latch 26 is now described. The latch 26 is made in one piece and includes upwardly curved and opposed outboard and inboard latch arms 28 and 30, respectively, connected in common at one end by an integral attachment fixture 74 and separated by an interlatch space 76. The outboard and inboard latch arms 28 and 30 also extend to include radiused curves 78 and 80 and to include planar bottom surfaces 82 and 84. The attachment fixture 74 is comprised of a central attachment fixture 74a, an outboard attachment fixture 74b, and an inboard attachment fixture 74c. The central attachment fixture 74a includes a slot 92 for snap engagement with a rounded crossmember pivot bar 73 connecting links 75 and 77 of the linkage 72. Slots 86 and 88 are located between the central attachment fixture 74a and the outboard and inboard attachment fixtures 74b and 74c for accommodation of members of the linkage 72. Slots 85 and 87 are included in the outboard and inboard attachment fixtures 74b and 74c facing the slots 86 and 88, respectively. Geometry adjacent the slots 86 and 88 opposing the attachment fixture 74 in the form of slots is provided for accommodation and snap engagement of externally located pivot pins 81 and 83 extending outwardly from the links 75 and 77, as shown in FIG. 5. A recess 90 (FIG. 5), which can be radiused, is

located generally between the attachment fixture 74 and the planar bottom surfaces 82 and 84 to accommodate the geometry of the actuator arm 32, as described later in detail. Pivot pins 94 and 95 having beveled ends project inwardly from the links 75 and 77, respectively, to connect to the attachment fixture 140 of the actuator arm 32. Opposing outboard and inboard posts 96 and 98, respectively, extend outwardly from the central regions of the outboard latch arm 28 and inboard latch 30, respectively, to align in opposed slots in the interior of the latch housing 24a, as described later in detail. The orientation of the attachment fixture 74, and thus the orientation of the latch 26, is influenced by a guide body 104, as later described in detail.

[0036] The latch housing 24a is now described with reference to FIGS. 4, 7 and 8. The latch housing 24a, which is substantially a one-piece structure and which is integral to and extends from the partially shown panel 22 (FIG. 4), includes an outboard sidewall 100; an inboard sidewall 102; top walls 106a and 106b; an opening 113 bounded by the outboard sidewall 100, the inboard sidewall 102, and the two top walls 106a and 106b; and a guide body 104 located centrally between the top walls 106a and 106b and being of one continuous integral piece with the top walls 106a and 106b as well as being of one continuous integral piece with a louver pin receptor post 108 extending from the panel 22. The top walls 106a and 106b extend in a profile partially common with and between part of the centrally located guide body 104 and portions of the outboard sidewall 100 and the inboard sidewall 102. Outboard and inboard slots 110 and 112, respectively, are located between the ends of the outboard sidewall 100 and inboard sidewall 102 and the centrally

located guide body 104 and the louver pin receptor post 108 for accommodation of the outboard latch arm 28 and the inboard latch arm 30 of the latch 26, as shown in FIG. 6. The opening 113 (FIG. 7) facing the opposing latch housing 24b is included between the outboard sidewall 100, the inboard sidewall 102, and the top walls 106a and 106b and the guide body 104 to accommodate one end of the latch 26, the linkage 72, and one end of the actuator arm 32, as shown later in detail.

[0037] The latch lock plate 70 frictionally engages and secures to a cutout 116 (FIG. 9) which is formed in part by the junction of the panel 22 and one edge each of the outboard and inboard sidewalls 100 and 102 and other edges adjacent thereto which form a cavity 118 in conjunction with the latch housing 24a. Outboard and inboard retainer bars 120 and 122, respectively, extend from the edges of a main panel 114 of the latch lock plate 70 to assist in forming an outboard slot 127 (denoted by dashed lines in FIGS. 8 and 12) and a corresponding and opposed inboard slot 129 (FIG. 8) in conjunction with the outboard and inboard configured cavities 124 and 126 (FIGS. 9 and 10). As shown in FIG. 12 and in respect to the outboard slot 127, the outboard retainer bar 120 occupies only a portion of the outboard configured cavity 124 leaving the unoccupied portion vacant to form the slot 127. The outboard slot 127 slidably accommodates the outboard post 96 of the latch 26. Accordingly, the inboard retainer bar 122 occupies a portion of the inboard configured cavity 126 to form the inboard slot 129 opposing the outboard slot 127 to slidably accommodate the inboard post 98 of the latch 26. One end of the main panel 114 includes a cutout 128 flanked by retainer catches 130 and 132, and the opposing end

of the main panel 114 includes retainer catches 134 and 136. The retain r catches 130, 132, 134 and 136 secure within the cutout 116 to secure the latch lock plate 70 to the panel 22. The cutout 128 accommodates the louver pin receptor post 108.

5 [0038] The actuating arm 32 includes an actuator arm main body 138 having an attachment fixture 140, which can be tubular, and an actuator arm gear receptor 142 oriented 90 degrees about the centerline of the actuator arm main body 138. A plurality of gear receptor cavities 144a-144n are located along the actuator arm gear receptor 142 for engagement with the actuator gear 34. A pivot hole 146 in the attachment fixture 140 slidingly engages and accommodates pivot pins 94 and 95 of the linkage 72 to attach the attachment fixture 140 of the actuator arm 32 to one end of the linkage 72, the rounded crossmember pivot bar 73 of the linkage 72 snappingly engages the slot 92 of the latch attachment fixture 74, and the slots 85 and 87 of the latch 26 snappingly engage and are accommodated by the pivot pins 81 and 83 of the linkage 72, thereby flexibly linking the actuator arm 32 to the latch 26. It is to be noted that one end of the linkage 72 is accommodated by the slots 86 and 88 adjacent to the central attachment fixture 74a.

20 [0039] The actuator gear 34 includes opposing shafts extending centrally from a gear 150. One shaft 152 includes surfaces, such as hexagonally arranged surfaces, suitable for manual operation or operation by a suitable tool. The shaft 152 is accommodated by a support hole 154 shown extending through a central panel 156 of the gear support housing 36. The opposing shaft 158 is accommodated by a support hole 160 (FIG. 7) located on the panel 22 between the opposing latch housings 24a and 24b. The shaft 158 includes

a suitably shaped receptacle hole 159 for an Allen wrench or other tool for actuation of the actuator gear 34 by a suitably shaped tool from the front of the four-point latching system 10.

5 [0040] The gear support housing 36 includes opposing panels 162 and 164 extending from the central panel 156 that include retainer catches 166 and 168, respectively, which are segmented and extend outwardly therefrom for snap engagement with opposing outboard and inboard slots 170 and 172, 10 respectively, located in the panel 22 of the main housing 12 to secure the gear support housing 36 to the panel 22 of the main housing 12.

[0041] FIG. 5 is an inverted view of the latch 26 and linkage 72 showing the relationship of the latch 26 to the linkage 72. Shown in particular are the slots 85, 87 and 92 which snappingly and rotatingly engage pivot pins 81 and 83 and the rounded crossmember pivot bar 73, respectively. The recess 90, part of which is radiused, accommodates the attachment fixture 140 of the actuator arm 32 and the slots 88 and 86 also accommodate a portion of the links 77 and 75 of the linkage 72, as shown in FIG. 17, during final rotational actuation of the latch 26. Also shown are the outboard and inboard latch arms 28 and 30 and the planar bottom surfaces 82 and 84 of the latch 26.

[0042] FIG. 6 is a view of the latch mechanism 20a being connected by the actuator arm 32 to the actuator gear 34. Especially shown is the relationship of the outboard latch arm 28 and the inboard latch arm 30 to the outboard slot 110 and the inboard slot 112, respectively, where the outboard latch arm 28 and the inboard latch arm 30 can be positioned horizontally within the outboard slot 110 and the inboard slot 112 as well as positioned toward the panel 22 in stages by action of the actuator gear 34 and the interceding actuator arm 32 with which the latch 26 can be positionally urged, as described herein.

[0043] FIG. 7 is a rear view of the main housing 12 where the gear support housings 36, the actuator gears 34, the actuator arms 32 and the latches 26 are not shown in order to reveal other structures residing on the panel 22. Shown in particular is the opening 113 of the latch housing 24a facing the opposing latch housing 24b and included between ends of the outboard sidewall 100 and inboard sidewall 102, ends of the top walls 106a and 106b and an end of the guide body 104 of the latch housing 24a to accommodate the placement of and the motion of one end of the latch 26 and one end of the connected actuator arm 32. Also shown on panel 22 is the support hole 160 which supports the shaft 158 of the actuator gear 34 and the outboard slot 170 and inboard slot 172 to which the outboard and inboard retainer catches 166 and 168 snappingly engage and secure.

[0044] FIG. 8 is a rear view of a portion of the latch housing 24a of the main housing 12 showing the relationship of the outboard slot 110 to the outboard sidewall 100, the top walls 106a and 106b, the guide body 104 and the louver pin receptor post 108, as well as the relationship of the inboard slot 112 to the inboard sidewall 102, the top walls 106a and 106b, the guide body 104 and the louver pin receptor post 108. The outboard and inboard slots 127 and 129 which slidingly engage the outboard post 96 and the inboard post 98 of the latch 26 are also shown in dashed lines.

[0045] FIG. 9 is a front view of the main housing 12 where the latch lock plates 70 and latches 26 are not shown in order to reveal other structures residing on the panel 22 including the geometry of the interior cavities 118 formed in part by the structure of the latch housings 24a-24n. Shown in particular are the outboard configured cavity 124 and the inboard configured cavity 126 (dashed lines) located in the outboard sidewall 100 and the inboard sidewall 102 of the latch housing 24a. Also shown are a plurality of support struts 174a-174n, the length of some of which are interrupted, connected to and extending along the panel 22 and between the members of the peripheral wall 13 of the main housing 12. Also shown is the relationship of the louver pin receptor post 108, being supported in part by the support strut 174a and in part by a portion of the panel 22, to the guide body 104 to which one end the louver pin receptor post 108 is attached. A partially shown transversely oriented recess 107 which is curved and elongated is located on the guide body 104 and influences the orientation of the latch 26. A planar surface 109 which influences the behavior and orientation of the latch 26 is also partially shown.

[0046] FIG. 10 is a front view of a portion of the latch housing 24a of the main housing 12 showing the relationship of the outboard slot 110 to the outboard sidewall 100, the top walls 106a and 106b, the guide body 104 and the louver pin receptor post 108, as well as the relationship of the inboard slot 112 to the inboard sidewall 102, the top walls 106a and 106b, the guide body 104 and the louver pin receptor post 108.

[0047] Also shown is a forward facing planar surface 109 being in common with the forward facing surfaces of the top walls 106a and 106b and one forward facing surface of the guide body 104. The planar surface 109 is adjacent to and abutting the recess 107 which is transversely oriented, curved and elongated and forward facing. The recess 107 is partially common to the top walls 106a and 106b and partially common to the guide body 104, extending transversely as a unitary recess 107. The recess 107 and the planar surface 109 serve sequentially as a guide to influence the orientation of the latch 26 where the orientation of the latch 26 can be restricted or unrestricted.

[0048] FIG. 11 is a view of the main housing 12 showing a portion thereof in cross section along line 11-11 of FIG. 8 and showing in exploded relationship components thereof prior to assembly. During assembly, the actuator
5 arm 32 and the linkage 72 are maneuvered through the opening 113 to connect to the latch 26. The beveled end pivot pins 94 and 95 of the linkage 72 spreadingly impinge the attachment fixture 140 to temporarily spread the links 75 and 77 to accommodate snapping engagement of the pivot pins 94 and 95 with the ends of the pivot hole 146 of the attachment fixture 140 to pivotally secure one end of the linkage 72 to the actuator arm 32. The rounded crossmember pivot bar 73 at the opposing end of the linkage 72 snappingly engages the slot 92 (FIG. 5) of the attachment fixture 74 and can be
10 pivoted therein, and the pivot pins 81 and 83 extending outwardly from the links 75 and 77, respectively, snappingly engage the innermost portions of the slots 85 and 77 of the latch 26 and can be pivoted therein. Such simultaneous pivoted engagements provide for pivotal attachment of the
15 actuator arm 32 to the latch 26 by the use of the intermediate linkage 72 and for the utilization of one or more pivotal axes about which the linkage 72 can be pivoted to influence the orientation of the latch 26 with respect to the actuator arm 32. FIGS. 12-17 illustrate the attachment of the actuator
20 arm 32 to the latch 26 by the interceding linkage 72 and the relationship thereof where an angular relationship of the linkage 72 to the actuator arm 32 is at first maintained to be followed by angular repositioning and displacement. As shown in FIG. 13, the longitudinal travel path 176 of a first
25 axis of pivotal rotation 178 centering about the co-located pivot hole 146 of the attachment fixture 140 and the pivot
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pins 94 and 95 of the linkage 72 is linear, constant, and straight; whereas the longitudinal travel path 180 of a second axis of pivotal rotation 182 which is rearward of and off center with respect to the longitudinal travel path 176 of the first axis of pivotal rotation 178 and which centers about the co-located rounded crossmember pivot bar 73, pivot pins 81 and 83, and the connected attachment fixture 74 is initially linear, constant, and straight but subsequently is urged and caused to be a greater distance rearward of the longitudinal travel path 176 of the first axis of pivotal rotation 178. Such repositioning of the second axis of pivotal rotation 182 more rearwardly causes rotation of the latch 26 about the outboard and inboard posts 96 and 98 of the latch 26 to forcefully reposition the outboard and inboard latch arms 28 and 30 towards the panel 22 and against an interceding tab 41 of the mounting panel assembly 39, as shown in FIGS. 17 and 18. Overcenter locking is also provided as described later in detail.

PROCESS

[0049] FIGS. 13-17 illustrate the process incorporating use of the electronic display module having a four-point latching system 10 into an electronic sign where FIG. 14 is a view of the main housing 12 showing a portion thereof in cross section like FIG. 11 but showing the components fully assembled, and where FIGS. 15, 16 and 17 are views like FIG. 13 showing in sequence the various stages of the process involving attachment of the main housing 12 and associated parts to a portion of the mounting panel assembly 39, such as shown in FIG. 18. FIG. 18 is a plan view showing the outboard latch arm 28 and the inboard latch arm 30 engaged over and about the tab 41 at the junction of the vertical plate 39a and the horizontal plate 39c of the mounting panel assembly 39. Although operation of only one of the latching points, such as illustrated by the latch mechanism 20a, is described, operation of the remaining latch mechanisms 20b, 20c and 20d is the same as described for the latch mechanism 20a.

[0050] The process shown in FIGS. 13, 14, 15, 16 and 17 involving the attachment of the electronic display module having a four-point latching system 10 to the mounting panel assembly 39 is best understood by first perusing the simple installation process where the process includes the steps of:

1. Rotating the actuator gears 34 to ensure full retraction of the latches 26 towards the actuator gears 34;
2. Positioning and aligning the locator posts 38a-38d of the main housing 12 with alignment holes 43 of the mounting panel assembly 39 and bringing the main

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- housing 12 into contact with the mounting panel assembly 39;
3. Rotating the actuator gears 34 to position the outboard latch arms 28 and the inboard latch arms 30 over tabs 41 of the mounting panel assembly 39; and,
 4. Continuing rotation of the actuator gears 34 to rotationally position the outboard latch arms 28 and the inboard latch arms 30 against the tabs 41 of the mounting panel assembly 39.

[0051] In FIGS. 14 and 15, each figure shows the same positioning of the latch 26 and the components connected thereto; and with respect to process step 1 above, elements of the invention are shown assembled as previously described, 5 whereby the greater portion of latch 26 is residing in the cavity 118 (FIG. 9) of the latch housing 24a in a retracted position. Such positioning places the latch 26 toward the actuator gear 34, and the outboard and inboard latch arms 28 and 30 remain in a position which would not have interfered 10 with the alignment of the main housing 12 with the tab 41 of the mounting panel assembly 39. Also shown is the shaft 158 of the actuator gear 34 in supportive engagement with the support hole 160 of panel 22 and the shaft 152 in supportive engagement with the support hole 154 of the gear support 15 housing 36 which engages the panel 22. The actuator gear 34 is shown in engagement with the actuator arm 32 which is attached to the latch 26 by the linkage 72. Although not shown, the actuator gear 34 also engages an actuator arm 32 connected with the latch mechanism 20b (FIG. 1) for simultaneous operation of latch mechanisms 20a and 20b. 20

[0052] When the locator posts 38a-38d are aligned with alignment holes 43 of the mounting panel assembly 39 and the main housing 12 is brought into contact with the mounting panel assembly 39, the actuator gear 34 is actuated to initially urge the actuator arm 32, the linkage 72 and the latch 26 in a direction towards the tab 41 of the mounting panel assembly 39 to a position as shown in FIG. 16.

[0053] The latch 26 is guided within the cavity 118 (FIG. 9) of the latch housing 24a by various components, 30 surfaces, protuberances and the like. The outboard post and the inboard post 96 and 98, respectively, of the latch 26

align in and are guided in part by the outboard and inboard slots 127 and 129 to guide the latch 26 while transiting the cavity 118 where the cavity 118 is bounded by the latch housing 24a and the latch lock plate 70.

5 [0054] The planar surface 109 and the recess 107 also lend to the guidance and orientation of the latch 26, as well as the linkage 72. Initially, as shown in FIGS. 14 and 15 and with respect to process step 3, as the actuator arm 32 urges the latch 26 towards the tab 41, the attachment fixture 74 including the central attachment fixture 74a and the outboard and inboard attachment fixtures 74b and 74c are in guided and stabilized contact with the planar surface 109. Force is transmitted from the actuator arm 32 to the latch 26 by the linkage 72 where the first and second axes centers of pivotal rotation 178 and 182 of the linkage 72 are distanced and prohibited from achieving an overcenter relationship (i.e., an almost straight line push force is maintained across the linkage 72). The orientation of the linkage 72 is maintained in a position nearly parallel to the force being exerted thereupon and to the planar surface 109 by the sliding contact of the entire attachment fixture 74 with the planar surface 109 and as such during such actuation, the orientation of the latch 26 and the linkage 72 is constrained and restricted with respect to orientation, as shown in FIGS. 14 and 15.

25 [0055] As the latch 26 is continually advanced, the latch 26 achieves a position where the outboard and inboard latch arms 28 and 30 are positioned over and about the tab 41, such as shown in FIG. 16. At this conjuncture and with respect to process step 4 above, the attachment fixture 74 discontinues an intimate contactual relationship with and is

no longer influenced by the planar surface 109, and the outboard and the inboard posts 96 and 98 reach the end of travel within and against the ends of the outboard and inboard slots 127 and 129. Continued movement of the actuator arm 32 exerts force against the linkage 72 and the latch 26. As the longitudinal movement of the latch 26 is discontinued, the only movement of the latch 26 which can take place is rotational movement about the outboard and inboard posts 96 and 98 positioned at the ends of the outboard and inboard slots 127 and 129 where such rotational movement is urged by the force applied longitudinally by the actuator arm 32 and the linkage 72. Whereas the second axis of pivotal rotation 182 is to the rearward of the first axis of pivotal rotation 178, the force applied to the linkage 72 causes the linkage 72 to be repositioned angularly where the rounded crossmember pivot bar 73, pivot pins 81 and 83, and pivotally connected attachment fixture 74 of the latch 26 (second axis of pivotal rotation 182) are urged rearwardly to be positioned in and to be accommodated by the recess 107 to a position as shown in FIG. 17. At the same time, the attachment fixture 140 is accommodated by the recess 90 in the latch 26 and the portions of the links 75 and 77 are accommodated by the slots 86 and 88 in the latch 26. Such forceful repositioning urges the outboard and inboard latch arms 28 and 30 towards the panel 22 and against the interceding tab 41 of the mounting panel assembly 39. Such forceful repositioning also provides a locking of the first axis of pivotal rotation 178 overcenter and slightly past the second axis of pivotal rotation 182 to maintain the rotated position of the latch 26 in the locked position against the mounting panel assembly 39.

[0056] Disengagement of the electronic display module having a four-point latching system 10 from the mounting panel assembly 39 is accomplished by actuating the actuator gears 34 in a reverse manner to cause re-orientation and movement of the actuator arm 32 towards the actuator gears 34 to reposition the linkage 72 from the overcenter locked position to disengage the outboard and inboard latch arms 28 and 30 from intimate contact with the tab 41 of the mounting panel assembly 39. The actuator gears 34 are further actuated in a reverse manner to retract the latch 26 from a position where the outboard and inboard latch arms 28 and 30 are overlying the mounting panel assembly 39. The linkage 72 during retraction assumes a position where the relationship of the first axis of pivotal rotation and the second axis of pivotal rotation does little to stabilize the orientation of the latch 26 during retraction. Stabilization of the latch 26 during retraction is influenced by the planar bottom surfaces 82 and 84 riding along the upper surface of the latch lock plate 70.

[0057] Various modifications can be made to the present invention without departing from the apparent scope thereof.

IT IS CLAIMED: